

CLAIMS

1. A copper alloy material in wire or bar form for forming a netted structure used in seawater, the copper alloy material comprising a composition containing: 62 to 91 mass% of Cu; 0.01 to 4 mass% of Sn; and the balance being Zn, the composition satisfying the relationship derived from the Cu content [Cu] and Sn content [Sn] in terms of mass%: $62 \leq [Cu] - 0.5[Sn] \leq 90$, wherein the copper alloy material has a phase structure including an α phase, a γ phase, and a δ phase, and the total area ratio of the α , γ , and δ phases is 95 to 100%.

2. The copper alloy material according to Claim 1, wherein the composition further contains at least one element X1 selected from the group consisting of 0.02 to 0.25 mass% of As, 0.02 to 0.25 mass% of Sb, 0.001 to 0.2 mass% of Mg, and 0.01 to 0.25 mass% of P, and the composition satisfies the relationship derived from the Cu content [Cu], Sn content [Sn], P content [P], and X1 total content [X1] except P in terms of mass%: $62 \leq [Cu] - 0.5[Sn] - 3[P] - 0.5[X1] \leq 90$, and wherein the total area ratio of the α , γ , δ phases is 95 to 100%.

3. The copper alloy material according to Claim 1, wherein the composition further contains at least one element X2 selected from the group consisting of 0.02 to 1.5

mass% of Al, 0.05 to 1.5 mass% of Mn, 0.02 to 1.9 mass% of Si, and 0.005 to 0.5 mass% of Ni, and the composition satisfies the relationship derived from the Cu content [Cu], Sn content [Sn], Al content [Al], Mn content [Mn], Si content [Si], and Ni content [Ni] in terms of mass%: $62 \leq [Cu] - 0.5[Sn] - 3.5[Si] - 1.8[Al] + [Mn] + [Ni] \leq 90$, and wherein the total area ratio of the α , γ , δ phases is 95 to 100%.

4. The copper alloy material according to Claim 2, wherein the composition further contains at least one element X2 selected from the group consisting of 0.02 to 1.5 mass% of Al, 0.05 to 1.5 mass% of Mn, 0.02 to 1.9 mass% of Si, and 0.005 to 0.5 mass% of Ni, and the composition satisfies the relationship derived from the Cu content [Cu], Sn content [Sn], P content [P], X1 total content [X1] except P, Al content [Al], Mn content [Mn], Si content [Si], and Ni content [Ni] in terms of mass%: $62 \leq [Cu] - 0.5[Sn] - 3[P] - 0.5[X1] - 3.5[Si] - 1.8[Al] + [Mn] + [Ni] \leq 90$, and wherein the total area ratio of the α , γ , δ phases is 95 to 100%.

5. The copper alloy material according to any one of Claims 1, 2, 3, and 4, wherein the phase structure has a total area ratio of the γ and δ phases of 10% or less.

6. The copper alloy material according to Claim 5, wherein the Cu content [Cu] and the Sn content [Sn] satisfy the relationship $1 \leq 0.06[Cu] - [Sn] \leq 4.5$ in terms of mass%.

7. A copper alloy material in wire or bar form for

forming a netted structure used in seawater, the copper alloy material comprising a composition containing: 62 to 91 mass% of Cu; 0.01 to 4 mass% of Sn; 0.0008 to 0.045 mass% of Zr; 0.01 to 0.25 mass% of P; and the balance being Zn, the composition satisfying the relationship derived from the Cu content [Cu], Sn content [Sn], and P content [P] in terms of mass%: $62 \leq [\text{Cu}] - 0.5[\text{Sn}] - 3[\text{P}] \leq 90$, wherein the copper alloy material has a phase structure including an α phase, a γ phase, and a δ phase, the total area ratio of the α , γ , and δ phases is 95 to 100%, and the average grain size is 0.2 mm or less after melt-solidification.

8. The copper alloy material according to Claim 7, wherein the composition further contains at least one element X3 selected from the group consisting of 0.02 to 0.25 mass% of As, 0.02 to 0.25 mass% of Sb, and 0.001 to 0.2 mass% of Mg, and the composition satisfies the relationship derived from the Cu content [Cu], Sn content [Sn], P content [P], and X3 total content [X3] in terms of mass%: $62 \leq [\text{Cu}] - 0.5[\text{Sn}] - 3[\text{P}] - 0.5[\text{X3}] \leq 90$, and wherein the total area ratio of the α , γ , δ phases is 95 to 100% and the average grain size is 0.2 mm or less after melt-solidification.

9. The copper alloy material according to Claim 7, wherein the composition further contains at least one element X4 selected from the group consisting of 0.02 to 1.5 mass% of Al, 0.05 to 1.5 mass% of Mn, 0.02 to 1.9 mass% of

Si, and 0.005 to 0.5 mass% of Ni, and the composition satisfies the relationship derived from the Cu content [Cu], Sn content [Sn], P content [P], Al content [Al], Mn content [Mn], Si content [Si], and Ni content [Ni] in terms of mass%: $62 \leq [\text{Cu}] - 0.5[\text{Sn}] - 3[\text{P}] - 3.5[\text{Si}] - 1.8[\text{Al}] + [\text{Mn}] + [\text{Ni}] \leq 90$, and wherein the total area ratio of the α , γ , δ phases is 95 to 100% and the average grain size is 0.2 mm or less after melt-solidification.

10. The copper alloy material according to Claim 8, wherein the composition further contains at least one element X4 selected from the group consisting of 0.02 to 1.5 mass% of Al, 0.05 to 1.5 mass% of Mn, 0.02 to 1.9 mass% of Si, and 0.005 to 0.5 mass% of Ni, and the composition satisfies the relationship derived from the Cu content [Cu], Sn content [Sn], P content [P], X3 total content [X3], Al content [Al], Mn content [Mn], Si content [Si], and Ni content [Ni] in terms of mass%: $62 \leq [\text{Cu}] - 0.5[\text{Sn}] - 3[\text{P}] - 0.5[\text{X3}] - 3.5[\text{Si}] - 1.8[\text{Al}] + [\text{Mn}] + [\text{Ni}] \leq 90$, and wherein the total area ratio of the α , γ , δ phases is 95 to 100% and the average grain size is 0.2 mm or less after melt-solidification.

11. The copper alloy material according to any one of Claims 7, 8, 9, and 10, wherein the Sn content [Sn], Zr content [Zr], and P content [P] of the composition satisfy the relationships $0.5 \leq [\text{P}]/[\text{Zr}] \leq 150$, $1 \leq [\text{Sn}]/[\text{Zr}] \leq 3000$,

and $0.2 \leq [\text{Sn}]/[\text{P}] \leq 250$ in terms of mass%.

12. The copper alloy material according to any one of Claims 7, 8, 9, 10 and 11, wherein the phase structure has a total area ratio of the γ and δ phases of 10% or less.

13. The copper alloy material according to Claim 12, the Cu content [Cu] and Sn content [Sn] of the composition satisfy the relationship $1 \leq 0.06[\text{Cu}] - [\text{Sn}] \leq 4.5$ in terms of mass%.

14. The copper alloy material according to any one of Claims 7, 8, 9, 10, 11, 12, and 13, wherein the primary crystal in melt-solidification is in the α phase.

15. The copper alloy material according to any one of Claims 7, 8, 9, 10, 11, 12, 13, and 14, wherein the copper alloy material has a crystal structure whose dendrite network is fractured after melt-solidification.

16. The copper alloy material according to Claim 15, wherein the two-dimensional crystal grain structure is in a circular form or a form similar to the circular form after melt-solidification.

17. The copper alloy material according to any one of Claims 7, 8, 9, 10, 11, 12, 13, 14, 15, and 16, wherein the composition contains an inevitable impurity being Fe and/or Ni, and the contents of inevitable impurities Fe and Ni are each 0.5 mass% or less.

18. The copper alloy material according to any one of

Claims 1, 2, 3, 4, 5, and 6, wherein the copper alloy material is a plastic-processed wire or bar produced by plastic processing of a casting material.

19. The copper alloy material according to any one of Claims 7, 8, 9, 10, 11, 12, 13, 14, 15, and 16, wherein the copper alloy material is a cast-processed wire or bar, or a combination-processed wire or bar produced by subjecting the cast-processed wire or bar to plastic processing.

20. A method for manufacturing the copper alloy material in wire or bar form as set forth in any one of Claims 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, and 19, the method comprising a casting step in which Zr is added in a form of a copper alloy containing Zr immediately before pouring, thus preventing the addition of an oxide and/or a sulfide of Zr.

21. The method for manufacturing the copper alloy material according to Claim 20, wherein the copper alloy containing Zr is a Cu-Zr alloy, a Cu-Zn-Zr alloy, or a Cu-Zr- or Cu-Zn-Zr-based alloy further containing at least one element selected from the group consisting of P, Mg, Al, Sn, Mn, and B.

22. A netted structure used in seawater, comprising the copper alloy material in wire or bar form as set forth in any one of Claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, and 19, the copper alloy material being

formed into a net or a grid.

23. The netted structure used in seawater according to Claim 22, wherein the copper alloy material is a waved wire having curved portions, and the netted structure has a rhombically netted form made by arranging a large number of the waved wires in parallel such that the adjacent waved wires are entwined with each other at the curved portions.

24. The netted structure used in seawater according to Claim 23, wherein the netted structure is used as a fish cultivation net.

25. The netted structure used in seawater according to Claim 24, wherein the fish cultivation net includes a reinforcing frame attached along the lower edge of the net in a ring-shaped manner, and the reinforcing frame maintains the shape of the lower edge of the net and applies a downward tension to the net.

26. The netted structure used in seawater according to Claim 25, wherein the reinforcing frame is formed of a pipe made of the same copper alloy as the material forming the net.